

1 **SYSTEM AND METHOD FOR ENHANCED HAVI BASED DEVICE**

2 **IMPLEMENTATION**

3 **BACKGROUND OF THE INVENTION**

4 1. **Field of the Invention**

5 The invention is a system and method for enhanced HAVi based device
6 implementation. Specifically, the invention is a system method for providing extended
7 functionality for a HAVi compatible device.

8 2. **Description of the Prior Art and Related Information**

9 Recently, a communications standard that allows all manner of digital consumer
10 electronics, or home devices, to communicate with each other has been established by
11 some of the world's leading manufacturers in the field. The standard, called the Home
12 Audio Video Interoperability, or HAVi, standard allows users to enjoy the convenience of
13 easy interoperability of these devices. The types of devices supported by HAVi include:
14 tuner, VCR, clock, camera, AV disc, display, amplifier, modem, and Web proxy.

15 A specification has been developed for the HAVi standard. The HAVi
16 specification was developed mainly for home entertainment audio visual (AV) networks,
17 providing high bandwidth for transmitting multiple AV streams and featuring easy plug-
18 and-play functionality, using an underlying IEEE-1394 digital interface. The HAVi
19 specification defines a set of APIs and middleware capable of automatically detecting
20 devices on the network, coordinating the functions of various devices, installing
21 applications and user interface software on each device, and ensuring interoperability
22 among multiple brands of devices. Some of the companies involved in developing the
23 specification are:

24 Grundig AG,
25 Hitachi Ltd.,
26 Matsushita Electric Industrial Co.,
27 Royal Philips Electronics,
28 Sharp Corporation,
29 Sony Corporation,

1 Thomson Multimedia, and
2 Toshiba Corporation.

3 The HAVi specification is currently in its first version, last updated January 18, 2000, and
4 ~~can be found in .pdf format at www.HAVi.com.~~

5 HAVi technology allows all devices on a HAVi network to be operated from
6 anywhere on the HAVi network, which is local in nature, using whichever device is
7 nearest to the user. HAVi is a digital audio-visual (AV) networking initiative that
8 provides a networking software specification for seamless interoperability among devices.
9 Equally important, the HAVi specification is AV-device-centric, so it has been designed
10 to meet the particular demands of digital audio and video. It defines an operating-system-
11 neutral middleware that manages multi-directional AV streams, event schedules, and
12 registries, while providing application program interfaces (APIs) for the creation of a new
13 generation of software applications. Whatever the brand of device, the focus is on the
14 control and content of digital AV streams. HAVi software takes advantage of the
15 powerful resources of chips built into modern audio and video devices to give users the
16 management function of a dedicated audio-video networking system.

17 The IEEE 1394 standard (by I.LINK or FIREWIRE) has been chosen as the
18 interconnection medium. IEEE 1394 has more than enough capacity to simultaneously
19 carry multiple digital audio and video streams around a local area, for example a house,
20 and provides support for digital copy protection. Leading suppliers of consumer
21 electronics are already committed to producing HAVi compatible devices.

22 The HAVi standard gives users instantly coordinated functionality among usable
23 devices without that user becoming a system administrator. Each device added to the
24 network automatically installs its own application and interface software. The complexity
25 and sophistication has been built into HAVi compatible devices, with the power of the
26 HAVi standard being harnessed to work behind in the background so that control is
27 simple for the user. As each device is added to a local HAVi network, it's automatically
28 registered by the system so that other devices know what it is capable of.

29 Devices may possess several functions across brands, which is not a problem with

1 the HAVi network because HAVi has standardized the application programming
2 interfaces of the most common AV functions. This means that a VCR can search for a
3 device that offers a clock with the time-of-day and automatically set its own timers.

4 HAVi's upgradeable nature means that users are able to increase the functionality
5 of devices as updates become available. Not even a home PC is required for a HAVi
6 network to operate.

7 Functions on a device or device within the HAVi networking system may be
8 controlled from another device within the system. For example, a search may be
9 performed for an available VCR to record a TV program, with commands being given via
10 a menu selection from another TV display.

11 Entertainment products from different manufacturers may communicate with each
12 other when connected into a HAVi network. A variety of VCR's, hi-fis, DVD players,
13 minidisc machines, active loudspeakers, set-top boxes may all be daisy-chained together
14 to be presented on a TV for a user to control from one remote control device.

15 HAVi compliant devices automatically announce their presence and capabilities to
16 every other device on the HAVi network, greatly simplifying installation and setup. The
17 user of the HAVi network simply may add a device on a plug-and-play basis.
18 Complicated and difficult installation instructions are not required. Nor is any
19 configuration of network addresses or device drivers required.

20 Today's i.LINK enabled camcorders and other devices are able to be controlled on
21 a HAVi network for basic functions. Most HAVi compliant devices come with their own
22 dynamic device control modules (DCMs). Updating functionality can be done by
23 downloading/uploading new capabilities via the Internet. Also, additional or replacement
24 products can simply be incorporated into the network.

25 As consumers incrementally build entertainment networks from a basic cluster to
26 a home network, exciting new applications will emerge to offer additional flexibility,
27 control and personalization to home entertainment. The HAVi standard makes it easier
28 for companies to build and market new application programs by using HAVi's API's or
29 programming in Java. Bridges will also be available to home control systems, security

1 systems, communication systems and PC based applications.

2 The HAVi architecture is intended for implementation on consumer electronics
3 (CE) devices and computing devices; it provides a set of services which facilitate
4 interoperability and the development of distributed applications on home networks.
5 HAVi is intended for, but not restricted to, CE devices supporting the IEEE Std 1394-
6 1995 [3] (and future extensions) and IEC 61883 [4] interface standards. Since a goal of
7 the HAVi architecture is to be future-proof, interoperability is more than a common
8 command set. HAVi is a software architecture that allows new devices to be integrated
9 into the home network and to offer their services in an open and seamless manner. The
10 HAVi Architecture provides: a set of software elements along with the protocols and
11 APIs needed to achieve interoperability; device abstraction and device control models; an
12 addressing scheme and lookup service for devices and their resources; an open execution
13 environment supporting visual presentation and control of devices, and providing runtime
14 support for third party applications; communication mechanisms for extending the
15 environment dynamically through plug-and- play capabilities; a versioning mechanism
16 that preserves interoperability as the architecture evolves; and management of
17 isochronous data streams. The specification describes the constructs HAVi implements to
18 support interoperability.

19 One of the basic operating elements used multiple times in HAVi networks
20 comprises a functional control module (FCM). A FCM is a HAVi software element that
21 provides an interface for controlling a specific functional component of a device. Another
22 basic element comprises a device control module (DCM). A DCM is a HAVi software
23 element that provides an interface for controlling general functions of a device. A DCM
24 provides the interface to the HAVi network, exposing a set of functionality to the
25 network. FCMs are functional building blocks that may be combined to create the total
26 functionality of a physical or virtual multimedia device. Two DCMs could use the same
27 set of FCMs to create two different virtual devices.

28 With reference to Fig. 1, the underlying structure for a HAVi network 100
29 comprises interconnected clusters 60 of HAVi devices 30. Typically, there will be several

1 clusters 60 in a network 100, with one per floor or one per room. Each cluster 60 will
2 work as a set of interconnected devices 30 to provide services to users. Often one device
3 30a will control other devices 30. However, the HAVi architecture is sufficiently flexible
4 to allow networks 100 with no single master control device.

5 The HAVi architecture supports legacy devices 30, i.e., devices 30 that are at least
6 not fully compatible with the HAVi specification. This is important since the transition to
7 networked devices 30 is gradual – with manufacturers not suddenly producing only
8 networked devices 30 and consumers not suddenly replacing their existing devices 30.
9 Legacy devices 30 can also be characterized by the degree to which they support 1394
10 and industry standard protocols for 1394 such as IEC 61883.

11 Each device 30 has, as a minimum, enough functionality to allow it to
12 communicate with other devices 30 in the system 100, with the exception of legacy
13 devices 30 which are handled as explained below. During the course of interaction,
14 devices 30 may exchange control information and data in a peer-to-peer fashion. This
15 ensures that, at the communication level, no one device 30 is required to act as a master or
16 controller for the system 100. However, it also allows a logical master or controller 30a
17 to impose a control structure on the basic peer-to-peer communication model. The HAVi
18 control model makes a distinction between controllers 30a and controlled devices 30. A
19 controller 30a is a device that acts as a host for a controlled device 30. A controlled
20 device 30 and its controller 30a may reside on the same physical device 30 or on separate
21 physical devices 30a. In terms of the HAVi control model, a controller 30a hosts a device
22 control module (DCM) for the controlled device 30. The control interface for a device 30
23 is exposed via an API of the DCM. This API is the only access point for applications to
24 control the device 30. For instance, an intelligent television in the family room might be
25 the controller 30a for a number of interconnected devices 30. A controlled device 30a
26 could contain Java bytecode that constructs a user interface for the device 30 and allows
27 external control of the device 30. When the devices 30 are first connected, the controller
28 30a obtains the user interface and control code for the device 30 comprising the DCM for
29 the device. An icon representing the device 30 may then appear on the television screen,

1 and manipulating the icon may cause elements of the DCM to actuate the represented
2 device or devices in prescribed ways. The network 100 allows a single device 30, or a
3 group of devices 30 communicating amongst themselves, to deliver a service to a user.
4 When it is necessary for a device 30 to interact with a user, a GUI for the device may be
5 presented on a device 30 with display capabilities (possibly the device in question or
6 possibly a different device).

7 With reference to Fig. 2., DCMs are a central concept to the HAVi architecture
8 and the source of flexibility in accommodating new devices 30 and features. A chart 200
9 in Fig. 2 illustrates how DCMs can be distinguished in several ways. The first DCM
10 characteristic is how the DCM is obtained by the controller. For example, the DCM may
11 be embedded. An embedded DCM is a DCM that is part of the resident software on a
12 controller 30a. A DCM may also be uploaded. An embedded DCM is one that is
13 obtained from some source external to the controller 30a and is dynamically added to the
14 software on the controller 30a.

15 The second characteristic is whether a DCM is controller 30a dependent or
16 controller 30a independent. For example, a DCM may be native. A native DCM is one
17 that is implemented for a specific platform. It may include machine code for a specific
18 processor or access platform specific APIs for a device. A DCM may comprise a
19 bytecode DCM. A bytecode DCM is one that is implemented in Java bytecode.

20 Finally, DCMs can be distinguished by their functionality, or, conversely, their
21 range of use. For example, a DCM may comprise a standard DCM. A standard DCM is
22 one that provides standard HAVi APIs. Such a standard DCM provides basic
23 functionality but is able to control a wide range of devices. A DCM may comprise a
24 proprietary DCM. A proprietary DCM is a DCM that provides vendor-specific APIs in
25 addition to the standard HAVi APIs. Such a proprietary DCM would offer additional
26 features and capabilities over a standard DCM but could control a narrower range of
27 devices, perhaps only a specific device 30 or model of a device 30.

28 A DCM, is a software abstraction of a device 30 providing device 30 specific
29 functionality to the HAVi network 100. HAVi applications will not communicate with a

1 device 30 directly but through the DCM of the device 30 or one of its FCMs. A DCM is a
2 HAVi object in the sense that it is registered in a general registry with other HAVi
3 objects, and can communicate with other HAVi objects via a general HAVi Messaging
4 System. DCMs and FCMs are registered with their type and a HAVi unique identifier
5 (HUID). The HUID allows applications to find the DCM or FCM after partial system
6 unavailability, as when the device 30 represented by the DCM is momentarily removed
7 from the network 100. A DCM provides a set of basic methods for device 30 control and
8 observation. The DCM can be used by HAVi devices 30 as well as any application.

9 A distinction is made between devices 30 which are each described to the network
10 100 by their DCM, and functional components of a device 30 which are described to the
11 network 100 by FCMs within the DCM for the device 30. A good example of this
12 distinction can be found in a normal TV set. Although the TV set is generally one
13 physical box, it contains several distinct controllable entities, e.g. the tuner, display, audio
14 amplifier, etc. The controllable entities within a device are called functional components.
15 The TV is the device 30 defined to the network with its DCM, and the functional
16 components are defined by FCMs within the DCM.

17 **SUMMARY OF THE INVENTION**

18 The invention is a system and method for providing extended functionality for a
19 HAVi compatible device. The HAVi compatible device is connectable to a HAVi
20 network. The extended functionality is defined by control data stored on a remote server
21 external to the HAVi network. The remote server is connected to an external network.
22 The external network comprises a network external to the HAVi network. The HAVi
23 network comprises several other HAVi compatible devices.

24 The system comprises an external network connection device for providing data
25 communications between the HAVi network and the remote server. The external network
26 connection device is connectable to the external network. The external network
27 connection device is for receiving the control data from the remote server.

28 The system further includes a control module, comprising a device control module
29 (DCM) containing a special functional control module (FCM). The control module is for

1 providing the extended functionality for the HAVi compatible device based on the control
2 data.

3 **BRIEF DESCRIPTION OF THE DRAWINGS**

4 Fig. 1 is a block diagram illustrating the underlying structure for a HAVi network
5 according to the prior art;

6 Fig. 2 is a chart illustrating how prior art DCMs can be categorized;

7 Fig. 3 is a block diagram illustrating a system for providing extended functionality for a
8 HAVi compatible device according to the present invention;

9 Fig. 4 is a flow diagram illustrating the steps performed in a method performed by the
10 system of Fig. 3; and

11 Fig. 5 a block and data flow diagram illustrating the components and a process for
12 retrieving control data from a remote server of the system of Fig. 3.

13 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

14 With reference to Fig. 3, a system for providing extended functionality for a HAVi
15 compatible device 30b is shown. The HAVi compatible device 30b is connectable to a
16 HAVi network 100. The extended functionality is defined by control data 422 stored on a
17 remote server 420 external to the HAVi network 100. The remote server 420 is connected
18 to an external network 350. The external network 350 comprises a network external to
19 the HAVi network 100. The HAVi network 350 comprises several other HAVi
20 compatible devices 30.

21 The system comprises an external network connection device 120 for providing
22 data communications between the HAVi network 100 and the remote server 420. The
23 external network connection device 120 is connectable to the external network 350. The
24 external network connection device 120 is for receiving the control data 422 from the
25 remote server 420.

26 The system further includes a control module, shown as device control module
27 (DCM) 32b containing a special functional control module (FCM) 34b in Fig. 3. The
28 control module 32b-34b is for providing the extended functionality for the HAVi
29 compatible device 30b based on the control data 422. In Fig. 3, the DCM 32b is shown

1 containing several FCMs 34 and the special functional control module 34b. The DCM
2 ~~32b is for presenting the functionality of the HAVi compatible device 30b to the HAVi~~
3 network 100.

4 The device control module 32b may be included on a master control device 30a
5 comprising a processor connected to the HAVi network 100. The processor 30 has a
6 ~~memory module 38 for storing the DCM 32b and functional control module 34b. DCMs~~
7 ~~32 for the other HAVi compatible devices 30 are present on the master control device 30,~~
8 with each of the DCMs containing FCMs 34 for those devices.

9 The processor 30a may further comprise the external network connection device
10 ~~120 as opposed to the external network connection device 120 being directly connected to~~
11 the network 120. The external network connection device 120 may comprise a modem,
12 cable modem, ISDN device, or DSL connector.

13 The processor 30a is for presenting the device control module 32b to a user of the
14 HAVi network 100 for providing the user with the capability of controlling the HAVi
15 compatible device 32a with the extended functionality. The device control module 32b is
16 presented with the its functional control modules 34-34b in the display presented by the
17 DCM 34b described in the HAVi specification. There is a FCM 34b for the legacy device
18 30b and an FCM 34b for a virtual device representing the functionality of a set of control
19 data 422 stored on a remote server 420. A single DCM 32b exposes the combined
20 functionality of the legacy device 30b and the control data 422 so that it has the same
21 DCM 32b interface as a more intelligent, or contemporary, non-legacy device, and
22 therefore causes the legacy device 30b to appear to the user as if it were a non-legacy
23 device 30b.

24 The HAVi compatible device 30b may comprise a legacy device wherein the
25 extended functionality is for causing the HAVi compatible device 30b to function as a
26 contemporary device with respect to a user of the HAVi network 100. For example, the
27 HAVi compatible device 30b may comprise a compact disk player not having built in
28 ability for presenting artist and song information for a compact disk inserted into the
29 compact disk player. The control data 422 may thus be for presenting artist and song

1 information for the compact disk to the user. The control data 422 would thus comprise
2 artist and song information matched to one or more identification codes read from the
3 compact disk such that the artist and song information may be presented to the user for
4 selection.

5 Another embodiment of the system comprises a first usable device 30b comprising
6 one of a plurality usable devices 30 capable of being connected to a local network 100.

7 Each usable device 30, 30a, 30b is capable of receiving commands from a user of the
8 local network 100.

9 The external network connection device 120 is for providing data communications
10 between the local network 100 and a remote server 420 connected to the external network
11 350. The external network connection device 120 is thus connectable to the external
12 network 350. The network connection device 120 is for receiving control data 422 from
13 the remote server 420. The control data 422 defines extended functionality for a first 30b
14 of the one or more of the plurality of usable devices 30-30b. One or more control
15 modules 32b-34b is for providing the extended functionality for the one or more usable
16 devices 30b based on the control data 422.

17 One usable device 30a of the plurality of usable devices comprises a processor
18 having a device control module 32b. The device control module 32b comprises a first
19 functional control module 34b for presenting the extended functionality through
20 presentation of the device control module 32b to a user of the processor 30a for
21 controlling the first usable device 30b, thereby allowing the user to use the extended
22 functionality.

23 The extended functionality comprises a plurality of extended functions for
24 controlling the first usable device 30b. The device control module 32b comprises a
25 plurality of functional control modules 34-34b. Each functional control module 34-34b
26 comprises a subset of the plurality of extended functions.

27 The plurality of usable devices 30, 30a, 30b may comprise two or more processors
28 30a. The device control module 32b may present a selected one of the functional control
29 modules 34-34b to each of the two or more processors 30a, thereby allowing a user of

1 each of the two or more processors 30a to control the first device 30b based on the
2 respective subset of extended functions of the respective functional control module 34-
3 34b presented to the respective processor 30a.

4 One or more device control modules 32c may be constructed from various
5 functional control modules 34 from other device control modules 32. This is useful for
6 usable devices 30 that may have functionality defined by functional control modules from
7 two or more different device control modules 32 that may present the device control
8 module 32c to the HAVi network 100 with those functional control modules 34.

9 With reference to Fig. 4 a flow diagram illustrating the steps performed in a
10 method for providing extended functionality for a HAVi compatible device 30b is shown.
11 The first step comprises providing data communications between the HAVi network 100
12 and the remote server 420, step 470. The next step is that the control data 422 is received
13 from the remote server 420, step 472. The extended functionality for the HAVi
14 compatible device 30b is then provided to a user of the HAVi network 100 based on the
15 control data 422, step 474. The step of providing the extended functionality to the user
16 comprises providing the user with the capability of controlling the HAVi compatible
17 device 30b with the extended functionality by presenting the device control module 32b
18 to the user of the HAVi network 100.

19 With reference to Fig. 5, a diagram illustrating the components and a process for
20 retrieving the control data 422 from the server 420 is shown. The server 420 contains the
21 control data 422. The control data 422 may be formatted into a database containing
22 control data records 424. Each control data record 424 includes, for example, control data
23 for a compact disk title. Each control data record 424 may include an identification code
24 426 provided by a publisher of the publisher of a respective compact disk.

25 The HAVi device 30b may be loaded with a compact disk 502 having an
26 identification code 504. When the compact disk 502 is loaded into the HAVi device 30b,
27 the identification code 504 is provided to the DCM 32b for the HAVi device 30b, step
28 550. The identification code 504 read from the compact disk 502 is forwarded to the
29 remote server 420, step 552. The identification code for the compact disk 504 is matched

1 with an identification code 426 in a control data record 424b. Title and artist information
2 from the control data record 424 is transmitted back to the FCM 34b of the DCM 32 that
3 provides the extended functionality for the HAVi device 30b, step 554. The artist and
4 title information may now be presented for selection by a user on one of the HAVi
5 devices 30, 30a or 30b in the HAVi network 300.

6 The above example illustrates operation of the system wherein the HAVi device
7 30b is a compact disk player. However, those skilled in the art would recognize other
8 combinations of HAVi devices 30 and types of control data 422. For example, the HAVi
9 device 30b may comprise a television set that does not have digital menu presentation
10 firmware built in. In this case, the control data record 424 that is matched may include
11 digital channel grid information for presenting local television program information. The
12 DCM 32b for the television 30b may convey a zip code or a geographic location code for
13 identifying the local television viewing area for the user. The geographic location code
14 may comprise the identification code 504 that is matched with the control data record
15 identification code 426 in the control data record 424. Local television program
16 information may thus be downloaded from the server 420 to the FCM 34b for
17 presentation on the viewing screen of the television 30b through the DCM 32b.

18 While the particular method and apparatus shown and described herein in detail is
19 fully capable of attaining the objects of this invention, it is understood that the description
20 and drawings represent the presently preferred embodiment of the invention and are, as
21 such, a representation of the subject matter which is broadly contemplated by the present
22 invention. It is further understood that the scope of the present invention fully
23 encompasses other embodiments that may become obvious to those skilled in the art, and
24 that the scope of the present invention is accordingly limited by nothing other than the
25 appended claims.